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4. NATURE AND EXTENT OF CONTAMINATION

This section assesses monitoring data to identify distributions of contaminants of potential concern associated with the Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC). Monitoring at RWMC has been conducted over time under a variety of programs and with differing objectives. Though locations for monitoring capabilities (e.g., aquifer monitoring wells, vadose zone lysimeters, and waste zone probes) were chosen based on individual program objectives, the common goal of all programs in choosing locations was to maximize the likelihood of detecting contamination. In other words, the monitoring network at RWMC has accreted over time and does not provide data that are statistically representative of environmental media. Though the network is biased toward detection, detections still are generally sparse and sporadic, typically near detection levels, with only a few trends limited to only a couple of specific locations in the shallow vadose zone. Migration is very limited, with no imminent threat to the aquifer except for carbon tetrachloride, a volatile organic compound (VOC) associated with Rocky Flats Plant weapons-production waste.

Contaminants of potential concern to human health identified in Section 3.4 are the emphasis in Section 4, but some discussion also is provided about ecological contaminants of potential concern that are not contaminants of potential concern to human health. Discussions focus on results from routine aquifer and vadose zone monitoring conducted by the Idaho Cleanup Project (ICP) and the U.S. Geological Survey (USGS).

The occurrence of each human health contaminant of potential concern in the following regions is discussed in subsequent sections, as indicated below and shown in Figure 4-1:

- **Waste zone**—contaminant inventories in waste at the time of disposal, waste streams that give rise to additional inventories of contaminants of potential concern through radioactive decay and ingrowth, and nuclear logging data and lysimeter data from the waste zone
- **Surface**—environmental monitoring data for soil, run-off, and vegetation
- **Vadose zone**—environmental monitoring data for soil moisture (i.e., water that accumulates in soil pores), perched water, soil vapor, interbed sediment (cores) or subsurface basalt samples (cores), and vapor
- **Aquifer**—environmental monitoring data for the aquifer.

Discussions that follow present data collected since the 1970s. Historical data sets are not available for all contaminants of potential concern in all media, especially for the vadose zone where sample volumes are limited and analytical priorities have changed over time. For example, monitoring for Cl-36 was not conducted until recent years. Therefore, timeframes represented by monitoring data vary among analytes and media. Also important is that data are presented by fiscal year (FY) quarters. Because the federal fiscal year begins October 1, the first quarter of a fiscal year represents October, November, and December of the previous calendar year.

Discussions are tailored to address any trends or patterns in the data. Graphs, tables, and illustrations of contaminants of potential concern in the environment are presented when data sets are large enough. Statistical uncertainty intervals are associated with these data; but to ensure that figures and tables are easy to read, the uncertainty intervals are not included.

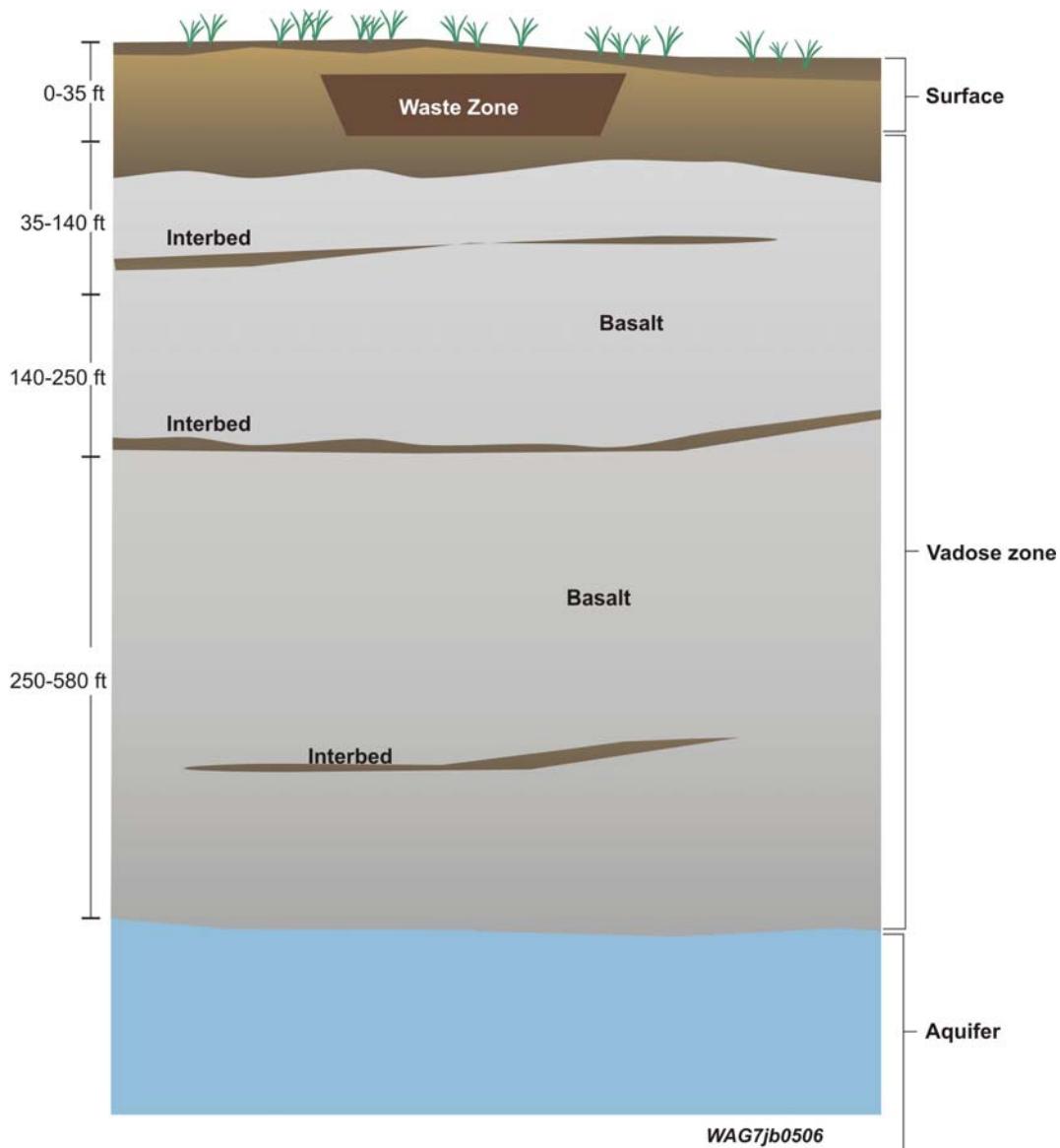


Figure 4-1. Depth intervals analyzed in evaluation of nature and extent of contamination.

4.1 Contaminants and Data Sources

Contaminants in the buried waste are grouped into three categories: radionuclides, inorganic contaminants, and volatile organic contaminants. These contaminants may be released from the buried waste and migrate either upward to the surface or downward through the vadose zone and possibly into the aquifer. The following discussion provides:

- Information, when available, about contaminants detected in four zones of interest: waste zone, surface, vadose zone, and aquifer
- Inventory of contaminants (i.e., estimated initial quantities of contaminants at time of disposal)
- Possible mechanisms for release of contaminants and parameters that affect the rate of release and migration

- Description of sampling and monitoring to verify inventory and assess the nature and extent of contamination
- Additional considerations related to interpretation of sampling and monitoring data.

4.1.1 Contaminants

Three types of contaminants of potential concern (i.e., radionuclides, inorganic contaminants, and VOCs) are sampled, analyzed, and interpreted under different protocols, as described in the following discussions.

Detected concentrations are typically interpreted by assessing them against comparison values. For concentrations in solid media (i.e., soil, core material, and solids filtered from samples), risk-based concentrations (RBCs) for soil are calculated. Calculations are based on a risk of 1E-05 or a hazard index of 1 for a 30-year residential exposure at the present time (i.e., no decay). Standard toxicity values and risk assessment techniques from U.S. Environmental Protection Agency (EPA) guidance (EPA 1989) are used to develop soil RBCs. The RBCs provide a scale for interpreting the significance of detected concentrations and are for comparison purposes only. For water (i.e., soil-moisture, perched water, and aquifer samples), maximum contaminant levels (MCLs) established by EPA are used. Because RWMC soil moisture and perched water are not drinking water sources, MCLs are not technically germane. However, MCLs provide a familiar context for comparing detected concentrations. In addition to soil RBCs and groundwater MCLs, background concentrations for soil and water provide information useful for evaluating constituents that occur naturally in the environment (e.g., nitrate and uranium isotopes) and for estimating detection frequencies. Table 4-1 presents background concentrations and comparison values for soil and water media.

4.1.1.1 Radionuclides. Radionuclide contaminants from the 1970s through August 2004 are discussed in this section. Each radionuclide is evaluated for the waste zone, surface, vadose zone media (i.e., core samples, soil moisture, and perched water), and aquifer. Positive detections in the environment are evaluated against comparison values provided in Table 4-1. Interpretation of radiological uncertainty associated with radiological results is provided in Section 4.1.6.2.

Throughout this section, terminology for radionuclides is as shown below, with the laboratory-reported uncertainty for each sample given by the standard deviation (σ):

- **Detection**—concentration is greater than 3σ and greater than the sample-specific minimum detectable concentration
- **Statistical detection**—concentration is greater than 2σ and less than or equal to 3σ
- **Unconfirmed detection**—concentration is greater than 3σ in an aquifer sample, but a second (replicate) analysis of another aliquot pulled from the same container does not yield a concentration greater than 3σ .

Historically, if radionuclides were detected in a lysimeter sample, additional sample volume was consumed in reanalysis to help confirm or refute the validity of the detection. From 1998 through most of 2003, reanalysis was triggered when radionuclides were detected at greater than 2σ . The 3σ reanalysis protocol was implemented near the end of 2003. Subsequently, the protocol for lysimeter samples was changed so that confirmation analyses were no longer conducted for radionuclide detections. The revised radionuclide protocol for lysimeters favors acquisition of data for various other priority analytes over confirmation of sporadic radionuclide detections. This change in protocol applies only to lysimeter samples; replicate analysis is always performed for positive actinide detections in aquifer samples.

Table 4-1. Background concentrations and comparison values for soil and water.

Contaminant	Concentration Range	Soil Background				Aquifer Background			
		95% Upper Tolerance Limits with 95% Confidence		Comparison Value for Soil ^a	Local Soil-Moisture Background ^c	Concentration Range	Commonly Observed ^b	Comparison Value for Water ^d	
		95% Lower Tolerance Limits with 95% Confidence	95% Upper Tolerance Limits with 95% Confidence						
Am-241	0.002 to 0.011 pCi/g ^e	0.011 pCi/g ^e	37 pCi/g	ND	ND	ND	ND	15 pCi/L (total alpha)	
C-14	NE	NE	2,845 pCi/g	ND	ND	NE	NE	2,000 pCi/L	
Cl-36	NE	NE	1,036 pCi/g	ND	ND	NE	NE	700 pCi/L	
Cs-137	0.01 to 0.96 pCi/g ^e	0.82 pCi/g ^e	183 pCi/g	ND	ND	0 to 134 pCi/L ^f	0 to 40 pCi/L	20,000 pCi/L	
H-3	NE	NE	NE	ND	ND	ND	ND	1 pCi/L	
I-129	NE	NE	29 pCi/g	ND	ND	ND	ND	1,070 pCi/L	
Nb-94	NE	NE	387 pCi/g	ND	ND	NE	NE	15 pCi/L (total alpha)	
Np-237	NE	NE	49 pCi/g	ND	ND	NE	NE	NE	
Pb-210	NE	NE	3 pCi/g	NE	NE	NE	NE	NE	
Pu-238	0.000 to 0.006 pCi/g ^e	0.0049 pCi/g ^e	29 pCi/g	ND	ND	ND	ND	15 pCi/L (total alpha)	
Pu-239/240	0.000 to 0.136 pCi/g ^e	0.10 pCi/g ^e	29 pCi/g	ND	ND	ND	ND	15 pCi/L (total alpha)	
Ra-226	0.80 to 1.36 pCi/g ^g 0.7 to 4.5 pCi/g ^h	NE	10.9 pCi/g	NE	0.01 to 0.37 pCi/L ^f	0 to 0.1 pCi/L	ND	5 pCi/L (total radium)	
Ra-228	0.14 to 0.21 pCi/g ^e	0.27 pCi/g ^e	3.5 pCi/g	NE	0 to 2.7 pCi/L ^f	0 to 0.3 pCi/L	ND	5 pCi/L (total radium)	
Sr-90	0.01 to 0.46 pCi/g ^e	0.49 pCi/g ^e	55 pCi/g	ND	ND	ND	ND	8 pCi/L	
Tc-99	NE	NE	1,036 pCi/g	ND	ND	NE	NE	900 pCi/L	
Th-228	0.45 to 1.70 pCi/g ^e	1.60 pCi/g ^e	9.81 pCi/g	NE	NE	NE	NE	NE	
U-233	NA	NA	50 pCi/g	NA	NA	NA	NE	NA ⁱ	
U-234	0.71 to 1.40 pCi/g ^e	1.44 pCi/g ^e	50 pCi/g	0 to 8.52 pCi/L	0.38 to 1.69 pCi/L ^j UTL = 1.92 pCi/L ^k	—	—	NA ⁱ	
U-235	0.073 to 0.103 pCi/g ^e	NA	49 pCi/g	0 to 1.34 pCi/L	0.01 to 0.15 pCi/L ^j	—	NA ⁱ	NA ⁱ	
U-236	NA	NA	53 pCi/g	NA	NA	NA	NA	NA ⁱ	

Table 4-1. (continued).

Contaminant	Concentration Range	Soil Background			Aquifer Background		
		95% Upper Tolerance Limits with 95% Confidence	Comparison Value for Soil ^a	Local Soil-Moisture Background ^c	Concentration Range	Concentrations Most Commonly Observed ^b	Comparison Value for Water ^d
U-238	0.80 to 1.36 pCi/g ^e	1.40 pCi/g ^e	38 pCi/g	0 to 3.86 pCi/L	0.17 to 0.90 pCi/L ^j UTL = 0.90 pCi/L ^k	—	NA ⁱ
Uranium (total)	NE	NE	NE	0 to 11.7 µg/L	0 to 7.0 µg/L 0.5 to 2.7 µg/L 0.3 to 3.6 µg/L ^l	0 to 3 µg/L	30 µg/L
Chromium (total)	1.05 to 47.8 mg/kg ^e	33 mg/kg ^e	NE	0 to 13 µg/L	1 to 22 µg/L ^m	—	100 µg/L
Carbon tetrachloride	NA ⁿ	NA ⁿ	NE	NA ⁿ	<0.2 µg/L	—	5 µg/L
1,4-Dioxane	NA ⁿ	NA ⁿ	NE	NA ⁿ	<0.2 µg/L	—	NE ^o
Methylene chloride	NA ⁿ	NA ⁿ	NE	NA ⁿ	<0.2 µg/L	—	5 µg/L
Tetrachloroethylene	NA ⁿ	NA ⁿ	NE	NA ⁿ	<0.2 µg/L	—	5 µg/L
Trichloroethylene	NA ⁿ	NA ⁿ	NE	NA ⁿ	<0.2 µg/L	—	5 µg/L

a. Calculated risk-based soil concentration equivalent to an increased cancer risk of 1E-05 or a hazard index of 1 for a 30-year residential scenario in the current time frame.

b. Table 1 of Knobel, Orr, and Cecil (1992).

c. Concentration range from Koeppen et al. 2005.

d. MCL from "National Primary Drinking Water Standards" (40 CFR 141) and *Implementation Guidance for Radionuclides* (EPA 2002).

e. Concentration range and upper tolerance limit from Rood, Harris, and White (1996).

f. Concentration range from Knobel, Orr, and Cecil (1992).

g. Concentration range assumes secular equilibrium with U-238 parent activity.

h. Based on gamma spectrometry analyses with no correction for U-235 interference.

i. MCL is not applicable to individual uranium isotopes, only to total uranium. To account for individual isotopes, detected U-233/234 is assumed to be U-234, and U-235/236 is assumed to be U-235, which is conservative and consistent with natural uranium; isotopic activities for U-234, -235, and -238 are then converted to mass, combined, and compared to the 30-µg/L MCL for total uranium.

j. Concentration range of aquifer monitoring wells near the Radioactive Waste Management Complex from 1998 through May 2005.

k. Upper tolerance limit from Leecaster, Koeppen, and Olson 2003.

l. Concentration range of aquifer monitoring wells at the INL Site (Roback et al. 2001).

m. Reduction to value from Knobel et al. (1999) to exclude high-chromium data near the Reactor Technology Complex (known source of chromium). Range is for total chromium.

n. Carbon tetrachloride, 1,4-dioxane, methylene chloride, tetrachloroethylene, and trichloroethylene do not occur naturally, and true background concentration should be zero; however, they may be found in the environment at trace concentrations because of use in a wide variety of industrial and household products.

o. MCL has not been established for 1,4-dioxane, but the U.S. Environmental Protection Agency has issued a health-based advisory level of 3 µg/L for drinking water.

MCL = maximum contaminant level

NA = not applicable

ND = nondetect; does not satisfy criteria for reportable detections (i.e., $X \leq 3\sigma <$ minimum detectable activity).

NE = not established

UTL = upper tolerance limit

4.1.1.2 *Inorganic Contaminants.*

Monitoring for inorganic contaminants began in 1992. Numerous results of anion and cation analysis have been significantly greater than soil moisture (lysimeter) background concentrations, and many results exceeded MCLs used for comparison. Most anions and cations are not contaminants of potential concern; however, some are mobile (e.g., chloride and sodium) and provide useful information about transport in the vadose zone beneath RWMC.

Results of analyzing many cations have varied greatly over the years. Many of the extreme values seem implausible because of inconsistency with past sampling results and probably are not representative of conditions in the vadose zone. Many maximum range values listed in the following tables were not replicated in subsequent sampling. In addition, some high values are possibly analytical anomalies, even though the reported data passed evaluation scrutiny. Interpretation of such inconsistent results is difficult because many of the anions and cations are indigenous to the environment and are naturally variable. Interpreting vadose zone analytical data also is compounded by the presence of magnesium chloride from historically applied dust suppressant, leachates from waste, possible corrosion of lysimeter units, and potential analytical anomalies. The cations are not contaminants of potential concern and are not discussed in detail in subsections that follow. However, data for a few cations, particularly those associated with dust suppressant, provide useful information and are discussed in the following subsection.

Approximately 400 inorganic analyses are generated each quarter; to reduce the size of tables, analytes that exceeded comparison values are shown with the concentration range observed since 1992, except for nitrate. Because nitrate is one of the contaminants of potential concern for Operable Unit 7-13/14, it is discussed separately in Section 4.19, followed by a discussion of chromium in Section 4.20 and other inorganic contaminants in Section 4.21.

4.1.1.3 *Volatile Organic Compounds.*

Carbon tetrachloride, tetrachloroethylene, methylene chloride, trichloroethylene, and 1,4-dioxane are VOCs that have been identified as contaminants of potential concern. Dissolved, sorbed, and vapor are the three phases of interest for these contaminants. In the subsurface, vapor transport is typically much more rapid than aqueous transport.

At RWMC, VOCs have been detected in samples of surficial sediment, vadose zone soil gas, vadose zone soil water (perched water and lysimeters), and the aquifer. Volatile organic compounds in vapor also have been detected emanating from the soil surface by surface isolation flux chambers. Carbon tetrachloride was first detected in groundwater in 1987 in a well just south of RWMC during reconnaissance monitoring by the USGS. Since then, samples of groundwater and vadose zone vapor routinely are analyzed for VOCs. Samples of vadose zone vapor are collected from permanent vapor sampling ports at depths ranging from a few feet below land surface to immediately above the aquifer. The number of vapor ports has increased from about 20 in 1988 to more than 200.

Since 1996, Operable Unit 7-08 has operated a system that removes soil gas from the subsurface by vapor vacuum extraction and destroys the VOCs by oxidizing them in a treatment unit. Vapor ports are sampled monthly from immediately around the SDA and quarterly from ports located further away from the SDA. Vapor is analyzed for VOCs with a photoacoustic multigas analyzer, but some field duplicate samples are sent to a laboratory for analysis using standard gas chromatography/mass spectrometry. Vapor concentrations have declined at most locations in response to operation of the vapor vacuum extraction system.

Vapor samples also are collected directly from the waste pits. These samples, obtained with Type B vapor port probes, are collected and analyzed quarterly for VOCs.

The primary source of VOCs is Series 743 sludge shipped from Rocky Flats Plant. The sludge was prepared by mixing various oils and solvents with calcium silicate until a thick paste was formed. The sludge was then placed in polyethylene bags inside 55-gal steel drums and buried in disposal pits at the SDA in the late 1960s. More information about disposal inventories and detection of compounds in environmental media is presented in Sections 4.22 through 4.26.

4.1.2 Waste Zone Data

The waste zone is generally defined by the boundaries of disposal units (e.g., pits and trenches) within the SDA, with a vertical profile extending to the first basalt layer beneath the SDA. Waste zone data include disposal and inventory records of waste buried in the SDA, shallow nuclear logging data from the Type A probe network, and contaminant concentrations in samples from Type B and Geologic and Environmental Probe System (GEOPS) lysimeters. Data collected outside the pits and trenches are discussed either in Section 4.1.3 as surface sample data or in Section 4.1.4 as components of the vadose zone data set.

Information collected as a result of analyzing waste zone samples acquired from Pit 9 (i.e., by the Operable Unit 7-10 Glovebox Excavator Method Project) is presented in Section 3.8. These data are not used to describe the nature and extent of contamination because Pit 9 samples are not representative of general conditions in the SDA or the surrounding environment. Pit 9 samples were collected from a very small region and were subject to potential cross-contamination. Section 3.8 provides a complete description of sample collection and analytical results.

4.1.2.1 Inventory Data. Tables 4-2 and 4-3 provide best-estimate inventories used to assess the nature and extent of contamination and to develop models and risk estimates for this remedial investigation and baseline risk assessment (RI/BRA). Table 4-2 lists total radionuclide inventories by waste generator for selected radioisotopes at the time of disposal. Table 4-3 summarizes chemical contaminants. Inventories associated with the Accelerated Retrieval Project are included in these tables. This RI/BRA characterizes risk predicated on the assumption that the Accelerated Retrieval Project (see Section 3.1.5.7) will be completed as a non-time-critical removal action (DOE-ID 2004a) before the Operable Unit 7-13/14 record of decision is prepared. Therefore, inventories associated with waste that is targeted for retrieval in the designated portion of Pit 4 are eliminated from the risk assessment but are included in assessing the existing nature and extent of contamination. Radionuclide inventories in the active Low-Level Waste (LLW) Disposal Facility (also called LLW Pit) within the SDA, including projections through an assumed closure date of 2009, also are incorporated.

Additional details associated with contaminant-specific waste streams are included in Table 4-4 (radionuclides), Table 4-5 (Rocky Flats Plant plutonium), Table 4-6 (nitrate and chromium), and Table 4-7 (VOCs). Waste streams contributing 1% or more of the total inventory are itemized, with remaining waste streams (i.e., those contributing less than 1%) listed collectively as miscellaneous.

Figures 4-2 through 4-29 are waste density maps that illustrate areas of high concentrations of each contaminant based on inventory at the time of disposal. Maps were generated from the RI/BRA snapshot inventory (McKenzie et al. 2005). The snapshot inventory represents information available in the Waste Information and Location Database in November 2004 and was sequestered to provide a stable data set for the baseline risk assessment. Note that “releaseable I-129” in Figure 4-6 and “releaseable Tc-99” in Figure 4-15, refer to iodine and technetium that are available for release into the surrounding soil through such mechanisms as surface wash.

Two methods were used to generate the data set used to build density maps: (1) a database query or (2) the scenario generator using mapping software (i.e., SDA Map Builder Application 8). The query

method accessed nuclide data, and the scenario method accessed chemical data. Because chemical data were not stored in a table that correlates chemicals to specific shipments, the scenario generator was used to partition chemical data to specific shipments based on the generator (i.e., the facility that produced the waste, such as Rocky Flats Plant) and waste type.

For a data set generated by query, the following steps were followed:

1. Query data from the snapshot inventory data set for nuclides of interest
2. Review the query to ensure that the resulting data set is complete and does not contain a query error
3. Identify all shipments and their locations containing the nuclide of interest
4. Create a data set containing the locations and values of the nuclide being mapped
5. Process the data set to generate a map layer showing the composite density of the nuclide of interest for every relevant location (i.e., locations with a shipment containing the nuclide of interest).

For a data set generated by a scenario, the following steps were followed:

1. Generate a scenario containing the chemical, its quantity, and the generator and waste types that would contain the chemical
2. Review the scenario for correctness
3. Run the scenario, generating a map layer.

The map layer, once generated by either of the two processes, is handled the same way:

1. Review the map layer
2. Process the map layer data to identify points that correspond to 25% breaks in the data based on inventory (i.e., by activity for radionuclides and by mass for nonradionuclides), and color-code breaks to aid in presentation of density data
3. Generate the density map with mapping software.

Each map contains a legend that provides mapped values, unmapped values, and snapshot values. Unmapped values are the total of discrepancies between the snapshot values (i.e., total inventories used in RI/BRA modeling and risk assessment) and the inventories shown on the maps. Discrepancies arise from two primary sources:

- Unknown disposal locations—some shipments have a value for the contaminant of potential concern but do not have a location for that shipment’s disposal. These inventories are included in the snapshot inventory totals but cannot be included in the density map.
- Rounding and calculation efficiencies.

Data shown in the inventory tables and density maps reflect inventories at the time of disposal. These data were pulled from the Waste Inventory Location Database, which provides information used to characterize the SDA source term. Supplemental information about the source term is found in Sections 3.3 and 3.4. Section 3.3 describes historical development and implementation of data sets culminating with the Waste Inventory Location Database. Section 3.4 summarizes the iterative contaminant screening applied to identify those contaminants being evaluated.

Table 4-2. Summary by waste generator of best-estimate inventories (curies) of selected radionuclides at the time of disposal in the Subsurface Disposal Area.

Radionuclide	Idaho Nuclear Technology Engineering Complex						Reactor Technology Complex			Low-Level Waste		
	Materials and Fuels Complex	Nuclear Reactors Facility	Rocky Flats Plant ^a	Test Area North	Others	Totals 1952 to 1999	2000 to 2009	Grand Total				
Ac-227 ^b	1.01E-09	1.90E-06	—	—	6.74E-07	7.19E-07	9.60E-07	4.26E-06	—	4.26E-06		
Am-241	7.14E+00	8.44E+00	1.19E+02	2.43E+05	7.87E+00	7.52E+00	3.47E-01	2.43E+05	1.19E+00	2.43E+05		
Am-243	9.23E-06	4.34E-02	—	—	7.59E-04	7.10E-02	5.31E-06	1.16E-01	1.88E-03	1.18E-01		
C-14	3.86E+01	2.57E+00	7.34E+01	—	1.70E-03	5.31E+02	1.04E+00	6.47E+02	8.46E+01	7.31E+02		
Cl-36	7.98E-03	1.41E-03	2.16E-01	—	1.06E-02	8.83E-01	5.00E-06	1.12E+00	5.38E-01	1.66E+00		
Cs-137	2.79E+04	6.70E+04	1.15E+04	1.31E+02	7.27E+03	2.77E+04	2.62E+04	1.68E+05	3.04E+02	1.68E+05		
I-129	8.57E-03	2.45E-02	9.21E-03	—	1.26E-03	9.28E-02	2.13E-03	1.38E-01	4.92E-02	1.88E-01		
Nb-94	5.65E+00	5.87E-01	3.17E+01	—	1.32E-02	9.39E+01	2.00E+00	1.34E+02	1.18E+01	1.46E+02		
Np-237	3.43E-02	6.86E-03	4.39E-03	—	2.90E-03	6.88E-02	1.19E-03	1.18E-01	2.28E-02	1.41E-01		
Pa-231	1.60E-08	9.08E-06	—	—	1.08E-05	2.58E-06	8.58E-04	8.81E-04	—	8.81E-04		
Pb-210	9.10E-06	4.25E-08	—	—	5.84E-09	1.06E-09	5.09E-07	9.66E-06	—	9.66E-06		
Pu-238	1.15E+01	7.04E+01	1.89E+01	1.85E+03	2.55E+00	1.30E+02	2.16E-01	2.08E+03	4.91E-01	2.08E+03		
Pu-239	5.12E+02	6.19E+00	4.68E+01	6.30E+04	1.45E+01	4.40E+00	5.01E+02	6.41E+04	5.07E-01	6.41E+04		
Pu-240	7.07E+00	9.26E-01	4.07E+01	1.41E+04	3.83E+00	8.22E-01	4.50E+02	1.46E+04	1.83E-01	1.46E+04		
Ra-226	2.29E+00	1.75E-04	—	1.90E-01	5.05E-03	2.25E-10	6.46E+01	6.71E+01	1.19E-01	6.73E+01		
Ra-228	—	8.71E-10	—	—	—	1.49E-07	1.07E-05	1.09E-05	2.57E-05	3.66E-05		
Sr-90	2.01E+04	6.31E+04	6.94E+03	—	4.44E+03	3.34E+04	8.22E+03	1.36E+05	1.09E+02	1.36E+05		
Tc-99	1.65E+01	1.10E+01	2.88E+00	—	7.19E-01	8.45E+00	6.43E-01	4.02E+01	2.09E+00	4.23E+01		
Th-228	8.20E+00	2.65E-01	—	—	7.66E-03	1.45E-03	2.00E+00	1.05E+01	1.18E-03	1.05E+01		
U-232	2.21E+00	8.86E-04	—	1.24E-02	4.88E-03	8.37E+00	3.51E-04	1.06E+01	5.41E-03	1.06E+01		
U-233	5.69E-04	2.16E-04	4.26E-04	5.40E-01	3.50E-01	6.01E-01	6.05E-01	2.10E+00	1.74E-02	2.12E+00		

Table 4-2. (continued).

Radionuclide	Idaho Nuclear Technology Engineering Complex						Reactor Technology Complex			Low-Level Waste 2000 to 2009			Grand Total
	Materials and Fuels Complex	Nuclear Reactors Facility	Nuclear Reactors Facility	Rocky Flats Plant ^a	Test Area North	Others	Totals 1952 to 1999	Totals 1952 to 1999	Totals 1952 to 1999	Totals 1952 to 1999	Totals 1952 to 1999	Totals 1952 to 1999	
U-234	3.37E+00	2.44E+00	8.44E-02	4.07E+01	6.58E+00	8.33E-02	1.02E+01	6.35E+01	4.07E-01	6.39E+01	6.39E+01	6.39E+01	
U-235	1.49E-01	1.02E+00	1.66E-03	2.15E+00	2.23E-01	5.25E-01	8.13E-01	4.88E+00	3.82E-02	4.92E+00	4.92E+00	4.92E+00	
U-236	1.08E-01	7.36E-02	1.20E-02	9.83E-01	7.38E-02	1.76E-01	3.67E-03	1.43E+00	1.75E-02	1.45E+00	1.45E+00	1.45E+00	
U-238	1.39E+00	3.40E-01	8.33E-02	1.29E+02	3.54E+00	4.52E-02	6.69E+00	1.41E+02	7.39E+00	1.48E+02	1.48E+02	1.48E+02	

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project at the Subsurface Disposal Area.

b. Includes Pu-241.

Table 4-3. Summary by waste generator of best-estimate inventories (grams) of selected chemicals buried in the Subsurface Disposal Area.

Chemical	Rocky Flats Plant	Other	Total
Carbon tetrachloride	7.90E+08	2.56E+04	7.90E+08
Chromium	2.32E+06	1.05E+03	2.32E+06
1,4-Dioxane	1.91E+06	4.09E+04	1.95E+06
Methylene chloride	1.41E+07	—	1.41E+07
Nitrate	4.06E+08	4.98E+07	4.56E+08
Tetrachloroethylene ^a	9.87E+07	—	9.87E+07
Trichloroethylene	8.92E+07	4.07E+05	8.96E+07

a. Tetrachloroethylene is also known as perchloroethylene.

Table 4-4. Radiological waste streams and best-estimate inventories (curies) at time of disposal.

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
Ac-227	INTEC-MOD-9H	18.0	7.68E-07	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	TRA-670-1N	16.9	7.19E-07	Beryllium waste
	CFA-690-1	16.4	7.00E-07	Metal—stainless steel
	INTEC-MOD-5H	10.1	4.32E-07	HEPA filter from the Waste Calcining Facility and other filters from miscellaneous facilities
	INTEC-MOD-6H	6.3	2.68E-07	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	INTEC-MOD-7H	6.2	2.63E-07	Contaminated soil from Tank Farm spills
	TAN-607-3N	5.7	2.45E-07	Activated core, loop components, end boxes, and stainless steel from the Stationary Low-Power Reactor No. 1
	TAN-633-5N	5.0	2.14E-07	Material as core structures, piping, clad assemblies, stainless steel, and combustible waste
	CFA-RWM-1	4.9	2.07E-07	Central Facilities Area Sewage Treatment Plant unpainted concrete rubble, drying beds soils, clarifier piping, and trickle filter bricks
	INTEC-MOD-4H	2.4	1.03E-07	One-time-only Navy experiment
	TAN-607-6RN	1.7	7.09E-08	Metal alloys, end boxes, combustible material, fuel assembly shrouds, concrete, resin, sludge, and equipment from the Hot Shop and Hot Cells (1984 to 1993)
	TAN-633-2N	1.5	6.24E-08	Hot Shop waste

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
Ac-227	D&D-ARA-1	1.2	5.23E-08	Waste stream consists primarily of contaminated metal and debris
	INTEC-MOD-2H	1.1	4.69E-08	Leached Vycor glass
	Miscellaneous ^b	2.6	1.06E-07	Various waste types
Total Ac-227		100.0	4.26E-06	
Am-241	RFO-DOW-3H	77.8	1.89E+05	Uncemented sludge
	RFO-DOW-4H	13.4	3.26E+04	Paper, rags, plastic, clothing, wood, and polyethylene bottles
	Pu-241 ingrowth	5.2	1.27E+04	Various Rocky Flats Plant waste streams
	RFO-DOW-12H	2.6	6.26E+03	Dirt, concrete, ash, and soot
	RFO-DOW-6H	0.9	2.01E+03	Filters
	Miscellaneous ^b	0.1	3.02E+02	Various waste types
Total Am-241		100.0	2.43E+05	
Am-243	TRA-670-1N	60.9	7.03E-02	Beryllium waste
	INTEC-MOD-9H	19.4	2.24E-02	General plant waste 1952 through 1983. Consists of metal, glass, paper, wood, clothing, plastic, dirt, and shielding material
	INTEC-MOD-5H	10.9	1.26E-02	HEPA filter from WCF and other filters from miscellaneous facilities
	Miscellaneous ^b	8.8	1.02E-02	Various waste types
Total Am-243		100.0	1.16E-01	
C-14	TRA-603-4N	46.0	3.36E+02	Core components
	TRA-670-1N	12.7	9.31E+01	Beryllium waste
	LLW—metal	9.8	7.17E+01	2000 to 2009 activated metal
	TRA-632-2N	7.8	5.72E+01	Hot Cell waste
	NRF-MOD-6H	5.2	3.82E+01	Core structural materials (1953 to 1983)
	TRA-603-27N	3.8	2.81E+01	Noncompactable waste (e.g., metal, wood, and glass)
	NRF-MOD-9H	2.3	1.65E+01	Sludge and resins from the Expended Core Facility and prototype plant operations (1953 to 1971)
	ANL-MOD-1H	2.2	1.60E+01	Irradiated subassembly hardware (1977 to 1983)
	ANL-MOD-1R	2.1	1.53E+01	Irradiated subassembly hardware (1984 to 1993)
	LLW—resins	1.1	7.87E+00	2000 to 2009 resins
	TRA-603-28N	1.0	7.40E+00	Miscellaneous contaminated materials

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	ANL-785-1	1.0	7.11E+00	Subassembly waste from nuclear fuel and materials experiments in the Hot Fuel Examination Facility (1994 to 1999)
	Miscellaneous ^b	5.0	3.67E+01	Mostly activated metal
Total C-14		100.0	7.31E+02	
Cl-36	TRA-670-1N	53.3	8.83E-01	Beryllium waste
	LLW—metal	32.5	5.38E-01	2000 to 2009 activated metal
	NRF-MOD-6H	9.5	1.58E-01	Core structural materials (1953 to 1983)
	NRF-MOD-6R	2.7	4.49E-02	Core structural materials (1984 to 1997)
	Miscellaneous ^b	2.0	3.32E-02	Mostly activated metal
Total Cl-36		100.0	1.66E+00	
Cs-137	INTEC-MOD-2H	27.9	4.69E+04	Leached Vycor glass
	OFF-ATI-1H	13.3	2.23E+04	Irradiated fuel and chemical by-products from nuclear research
	TRA-632-2N	9.8	1.64E+04	Hot Cell waste
	ANL-MOD-5H	8.3	1.39E+04	General plant waste, mostly from decontamination (1952 to 1983)
	NRF-MOD-1H	6.3	1.06E+04	Shippingport fuel material, solid (1960 to 1968)
	INTEC-MOD-9H	4.8	8.00E+03	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	TRA-603-9N	3.8	6.43E+03	Fuel materials (solids, not dissolved)
	ANL-MOD-2H	2.9	4.82E+03	Irradiated and unirradiated fuel specimens (1971 to 1983)
	TRA-603-28N	2.7	4.53E+03	Miscellaneous contaminated materials
	INTEC-MOD-5H	2.7	4.51E+03	HEPA filter from the Waste Calcining Facility and other filters from miscellaneous facilities
	ANL-MOD-3H	2.5	4.26E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952 to 1970)
	INTEC-MOD-6H	2.5	4.12E+03	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	ANL-MOD-2HEXT	2.4	4.00E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984-1993)
	TAN-607-3N	2.3	3.86E+03	Activated core, loop components, end boxes, and stainless steel from the Stationary Low-Power Reactor No. 1

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	INTEC-MOD-7H	1.6	2.77E+03	Contaminated soil from Tank Farm spills
	Miscellaneous ^b	6.2	1.05E+04	Various waste types
Total Cs-137		100.0	1.68E+05	
I-129	TRA-603-1N	44.6	8.38E-02	Resins
	LLW—resins	24.8	4.65E-02	2000 to 2009 resins
	INTEC-MOD-2H	9.6	1.80E-02	Leached Vycor glass
	NRF-MOD-10H	2.5	4.78E-03	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952 to 1983)
	TRA-632-2N	2.3	4.27E-03	Hot Cell waste
	NRF-MOD-1H	2.1	3.90E-03	Shippingport fuel material, solid (1960 to 1968)
	ANL-MOD-5H	1.9	3.52E-03	General plant waste, mostly from decontamination (1952 to 1983)
	LLW—trash	1.4	2.71E-03	2000 to 2009 miscellaneous LLW
	INTEC-MOD-9H	1.4	2.56E-03	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	TRA-603-28N	1.3	2.38E-03	Miscellaneous contaminated materials
	PBF-620-1	1.0	1.90E-03	Ion-exchange resins
	Miscellaneous ^b	7.1	1.34E-02	Mostly fuel-contaminated waste
Total I-129		100.0	1.88E-01	
Nb-94	TRA-603-4N	45.5	6.63E+01	Core components
	NRF-MOD-10H	16.5	2.40E+01	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952 to 1983)
	TRA-632-2N	9.5	1.39E+01	Hot Cell waste
	LLW—resins	6.2	8.94E+00	2000 to 2009 resins
	TRA-603-27N	4.7	6.83E+00	Noncompactable waste (e.g., metal, wood, and glass)
	NRF-MOD-6H	3.5	5.06E+00	Core structural materials (1953 to 1983)
	LLW—metal	1.9	2.83E+00	2000 to 2009 activated metal
	TRA-603-1N	1.9	2.82E+00	Resins
	ANL-MOD-1H	1.9	2.81E+00	Irradiated subassembly hardware (1977 to 1983)
	ANL-MOD-1R	1.8	2.55E+00	Irradiated subassembly hardware (1984 to 1993)
	D+D-S1G-1H	1.4	2.00E+00	Decontaminated reactor vessel and processing equipment, components, and piping
	TRA-603-28N	1.2	1.79E+00	Miscellaneous contaminated materials

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	TRA-603-9N	1.0	1.50E+00	Fuel materials (solids, not dissolved)
	Miscellaneous ^b	3.0	4.26E+00	Various waste types
Total Nb-94		100.0	1.46E+02	
Np-237	TRA-632-2N	24.9	3.52E-02	Hot Cell waste
	LLW—trash	16.1	2.28E-02	2000 to 2009 miscellaneous LLW
	TRA-603-28N	13.9	1.96E-02	Miscellaneous contaminated materials
	TRA-603-9N	8.9	1.26E-02	Fuel materials (solids, not dissolved)
	ANL-MOD-5H	7.9	1.12E-02	General plant waste, mostly from decontamination (1952 to 1983)
	ANL-763-1	5.4	7.55E-03	Soil, rocks, concrete, and sludge solidified with grout from cleanup of Experimental Breeder Reactor II leach pit
	ANL-MOD-4H	3.1	4.37E-03	Low or unirradiated bulk-actinide waste
	ANL-MOD-2H	2.7	3.88E-03	Irradiated and unirradiated fuel specimens (1971 to 1983)
	ANL-MOD-3H	2.4	3.43E-03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952 to 1970)
	ANL-MOD-2HEXT	2.3	3.23E-03	Irradiated and unirradiated fuel and fuel-contaminated materials (1984 to 1993)
	INTEC-MOD-9H	1.9	2.72E-03	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	NRF-MOD-1H	1.9	2.66E-03	Shippingport fuel material, solid (1960 to 1968)
	INTEC-MOD-5H	1.1	1.53E-03	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities
	Miscellaneous ^b	7.5	1.05E-02	Various waste types
Total Np-237		100.0	1.41E-01	
Pa-231	D&D-ARA-1	97.2	8.56E-04	Waste stream consists primarily of contaminated metal and debris
	Miscellaneous ^b	2.8	2.46E-05	Various waste types
Total Pa-231			8.81E-04	
Pb-210	ALE-ALE-1H	94.2	9.10E-06	Building rubble, electric wires, piping, machinery, radioactive tracers and sources, glass, gloves, paper, filters, and vermiculite
	Miscellaneous ^b	5.8	5.59E-07	Various waste types
Total Pb-210		100.0	9.66E-06	

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
Pu-238	Rocky Flats	88.7	1.85E+03	See Rocky Flats Plant plutonium table
	TRA-632-2N	3.2	6.68E+01	Hot Cell waste
	TRA-603-28N	1.8	3.72E+01	Miscellaneous contaminated materials
	INTEC-MOD-9H	1.6	3.36E+01	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	TRA-603-9N	1.2	2.39E+01	Fuel materials (solids, not dissolved)
	Miscellaneous ^b	3.5	7.30E+01	Mostly debris, some fuel-contaminated waste
Total Pu-238		100.0	2.08E+03	
Pu-239	Rocky Flats	94.7	6.07E+04	See Rocky Flats Plant plutonium, Table 4-5
	Rocky Flats	3.6	2.33E+03	See Rocky Flats Plant plutonium, Table 4-5
	Miscellaneous ^b	1.7	1.08E+03	Mostly fuel-contaminated waste
	Total Pu-239	100.0	6.41E+04	
Pu-240	Rocky Flats	93.0	1.35E+04	See Rocky Flats Plant plutonium, Table 4-5
	Rocky Flats	3.6	5.20E+02	See Rocky Flats Plant plutonium, Table 4-5
	OFF-LRL-2H	3.1	4.49E+02	Concrete, bricks, and asphalt
	Miscellaneous ^b	0.3	5.39E+01	Various waste types
	Total Pu-240	100.0	1.46E+04	
Ra-226	OFF-USN-1H	66.4	4.33E+01	Animal carcasses, waste paper towels, glassware, tools, and similar laboratory items
	OFF-ISC-1H	15.3	1.00E+01	Magnesium-thorium scrap, laboratory equipment, and sources
	OFF-AEF-1H	10.2	6.67E+00	Scrap metal, combustibles, glass, and concrete
	OFF-DPG-1H	5.1	3.33E+00	Animal and laboratory waste
	OFF-HEW-1H	1.5	1.00E+00	Radium-contaminated laboratory waste
	Miscellaneous ^b	1.5	9.50E-01	Various waste types
	Total Ra-226	100.0	6.53E+01	
Ra-228	Projected	70.3	2.57E-05	Projected waste
	WER-CMP-1	29.3	1.07E-05	Compacted waste: combination of glass, plastic, absorbents, cloth, paper, and wood
	Miscellaneous ^b	0.4	1.55E-07	Various waste types
	Total Ra-228	100.0	3.66E-05	
Sr-90	INTEC-MOD-2H	31.3	4.26E+04	Leached Vycor glass
	TRA-632-2N	12.7	1.73E+04	Hot Cell waste
	ANL-MOD-5H	7.4	1.01E+04	General plant waste, mostly from decontamination (1952 to 1983)

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	TRA-603-28N	7.1	9.62E+03	Miscellaneous contaminated materials
	INTEC-MOD-9H	5.9	8.00E+03	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	NRF-MOD-1H	4.6	6.24E+03	Shippingport fuel material, solid (1960 to 1968)
	TRA-603-9N	4.5	6.18E+03	Fuel materials (solid, not dissolved)
	INTEC-MOD-5H	3.3	4.51E+03	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities
	INTEC-MOD-6H	3.1	4.24E+03	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	ANL-MOD-2H	2.6	3.48E+03	Irradiated and unirradiated fuel specimens (1971 to 1983)
	ANL-MOD-3H	2.3	3.08E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952 to 1970)
	ANL-MOD-2HEXT	2.1	2.90E+03	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984 to 1993)
	INTEC-MOD-7H	2.0	2.78E+03	Contaminated soil from Tank Farm spills
	ARA-616-1H	1.6	2.16E+03	Scrap metal, resin, burnable materials, sludge, and some boric acid crystals from Mobile Low-Power Reactor No. 1 and Gas-Cooled Reactor Experiment
	TAN-607-6RN	1.2	1.65E+03	Metal alloys, end boxes, combustible material, fuel assembly shrouds, concrete, resin, sludge, and equipment from Hot Shop and Hot Cells (1984 to 1993)
	ARA-602-3H	1.2	1.60E+03	Hot Cell waste consisting of some fuel residue
	ARA-602-1H	1.0	1.38E+03	Miscellaneous debris from the Stationary Low-Power Reactor No. 1 cleanup (e.g., 1,000-gal tank, demineralizer with resin, building materials, pipes, soil, wire, concrete, and insulation)
	Miscellaneous ^b	6.1	8.55E+03	Mostly debris waste
Total Sr-90		100.0	1.36E+05	
Tc-99	ANL-MOD-1H	16.3	6.88E+00	Irradiated subassembly hardware (1977 to 1983)
	INTEC-MOD-2H	15.8	6.67E+00	Leached Vycor glass
	ANL-MOD-1R	14.8	6.24E+00	Irradiated subassembly hardware (1984 to 1993)
	TRA-603-1N	8.0	3.37E+00	Resins
	TRA-632-2N	6.2	2.60E+00	Hot Cell waste

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	LLW—resins	4.8	2.05E+00	2000 to 2009 resins
	ANL-MOD-5H	4.0	1.70E+00	General plant waste, mostly from decontamination (1952 to 1983)
	INTEC-MOD-9H	3.8	1.60E+00	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	NRF-MOD-1H	3.5	1.49E+00	Shippingport fuel material, solid (1960 to 1968)
	TRA-603-28N	3.4	1.45E+00	Miscellaneous contaminated materials
	NRF-MOD-10H	2.8	1.19E+00	Compactable and noncompactable waste from Expended Core Facility and prototype plant operations (1952 to 1983)
	TRA-603-9N	2.2	9.30E-01	Fuel materials (solids, not dissolved)
	INTEC-MOD-5H	2.1	8.84E-01	HEPA filter from Waste Calcining Facility and other filters from miscellaneous facilities
	INTEC-MOD-6H	1.9	8.20E-01	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	D&D-ARA-1	1.5	6.42E-01	Contaminated metal and debris from decontamination and demolition of Auxiliary Reactor Area facilities
	ANL-MOD-2H	1.4	5.89E-01	Irradiated and unirradiated fuel specimens (1971 to 1983)
	INTEC-MOD-7H	1.3	5.51E-01	Contaminated soil from Tank Farm spills
	ANL-MOD-3H	1.2	5.20E-01	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952 to 1970)
	ANL-MOD-2HEXT	1.2	4.90E-01	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984 to 1993)
	Miscellaneous ^b	3.8	1.59E+00	Various waste types
Total Tc-99		100.0	4.23E+01	
Th-228	ALE-317-2R	78.3	8.20E+00	Cloth, paper, wood, plastic, cut-up scrap, cut-up glove boxes, and other general plant waste
	CEG-CEG-1R	19.1	2.00E+00	Powder solidified in Aquaset
	INTEC-MOD-9H	1.3	1.30E-01	General plant waste (e.g., metal, glass, paper, wood, clothing, plastic, dirt, and shielding material) (1952 to 1983)
	Miscellaneous ^b	1.3	1.30E-01	Various waste types
Total Th-228		100.0	1.05E+01	

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
U-232	TRA-603-9N	79.0	8.36E+00	Fuel materials
	ALE-317-2R	20.9	2.21E+00	Cloth, paper, wood, plastic, cut-up scrap, cut-up glove boxes, and other general plant waste
	Miscellaneous ^b	0.1	1.73E-02	Various waste types
Total U-232		100.0	1.06E+01	
U-233	TRA-603-9N	28.4	6.01E-01	Fuel materials
	ARA-626-1H	28.4	6.00E-01	Some fuel scraps, waste from disassembly of facilities and Hot Cell waste
	RFO-DOW-19H	25.5	5.40E-01	U-233
	SMC-628-2	14.2	3.01E-01	Unsolidified slag
	SMC-990-1	1.3	2.74E-02	Metals, glass, and gravel contaminated with depleted uranium
	SMC-628-1	1.1	2.21E-02	Nonacidic evaporator sludge
	Miscellaneous ^b	1.1	2.43E-02	Various waste types
Total U-233		100.0	2.12E+00	
U-234	RFO-DOW-18H	33.7	2.15E+01	Enriched uranium
	RFO-DOW-16H	22.7	1.45E+01	Depleted uranium
	PDA-RFO-1A	7.3	4.64E+00	Evaporator salt (nitrate) and roaster oxides (depleted uranium)
	OFF-ATI-1H	5.7	3.64E+00	Irradiated fuel and chemical by-products from nuclear research
	OFF-GEC-1H	4.6	2.95E+00	Core, reactor vessel, and loop components
	TAN-607-3N	3.6	2.33E+00	Activated core, loop components, end boxes, and stainless steel from the Stationary Low-Power Reactor No. 1
	TAN-607-2	2.9	1.83E+00	TAN Hot Shop noncompactable waste
	INTEC-MOD-6H	2.4	1.56E+00	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	OFF-CSM-1H	2.0	1.30E+00	Magnesium fluoride slag with 1% natural uranium, steel metallic salt and silicate, miscellaneous laboratory waste
	ANL-MOD-2R	1.5	9.47E-01	Bulk actinide waste from the Zero Power Plutonium Reactor and other facilities
	ANL-MOD-5H	1.3	8.41E-01	General plant waste, mostly from decontamination (1952 to 1983)
	ANL-MOD-4H	1.2	7.48E-01	Low or unirradiated bulk-actinide waste
	ALE-317-2R	1.1	7.10E-01	Cloth, paper, wood, plastic, cut-up scrap, cut-up glove boxes, and other general plant waste

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	ARA-627-1H	1.0	6.38E-01	Plastic bags, brick, HEPA filters, scrap, glove boxes, and fuel
	Miscellaneous ^b	9.0	5.73E+00	Mostly scrap metal
Total U-234		100.0	6.39E+01	
U-235	RFO-DOW-16H	22.0	1.08E+00	Depleted uranium
	INTEC-MOD-3H	19.3	9.47E-01	Unirradiated and irradiated fuel specimens from natural and depleted fuel mock-ups
	RFO-DOW-18H	15.1	7.44E-01	Enriched uranium
	TRA-603-9N	9.9	4.86E-01	Fuel materials (solids, not dissolved)
	PDA-RFO-1A	6.6	3.25E-01	Evaporator salt (nitrate) and roaster oxides (depleted uranium)
	WAG-WG7-02	3.7	1.80E-01	Acid Pit in situ stabilization treatability study
	OFF-GEC-1H	3.2	1.57E-01	Core, reactor vessel, and loop components
	OFF-ATI-1H	2.3	1.14E-01	Irradiated fuel and chemical by-products from nuclear research
	TAN-607-3N	1.6	8.00E-02	Activated core, loop components, end boxes, and stainless steel from the Stationary Low-Power Reactor No. 1
	OFF-CSM-1H	1.6	8.00E-02	Magnesium fluoride slag with 1% natural uranium, steel metallic salt and silicate, miscellaneous laboratory waste
	OFF-GDA-1H	1.4	7.00E-02	Fuel fabrication items, laboratory equipment, activated metal, and irradiated fuel
	INTEC-MOD-6H	1.1	5.38E-02	CPP-603 resins (i.e., basin sludge and miscellaneous storage basin Zeolite filters)
	Miscellaneous ^b	12.2	5.98E-01	Mostly fuel-contaminated waste
Total U-235		100.0	4.92E+00	
U-236	RFO-DOW-16H	62.4	9.03E-01	Depleted uranium
	TRA-632-2N	6.3	9.07E-02	Hot Cell waste
	RFO-DOW-18H	5.6	8.04E-02	Enriched uranium
	INTEC-MOD-3H	4.1	6.00E-02	Unirradiated and irradiated fuel specimens from natural and depleted fuel mock-ups
	ANL-MOD-5H	3.7	5.42E-02	General plant waste, mostly from decontamination (1952 to 1983)
	TRA-603-28N	3.5	5.05E-02	Miscellaneous contaminated materials
	SMC-628-2	3.0	4.37E-02	Unsolidified slag
	TRA-603-9N	2.3	3.28E-02	Fuel materials (solids, not dissolved)
	ANL-MOD-2H	1.3	1.87E-02	Irradiated and unirradiated fuel specimens (1971 to 1983)

Table 4-4. (continued).

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	LLW—trash	1.2	1.75E-02	2000 to 2009 miscellaneous LLW
	ANL-MOD-3H	1.1	1.66E-02	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1952 to 1970)
	ANL-MOD-2HEXT	1.1	1.56E-02	Irradiated and unirradiated dissolved fuel and fuel-contaminated materials (1984 to 1993)
	Miscellaneous ^b	4.4	6.43E-02	Mostly fuel-contaminated waste
Total U-236		100.0	1.45E+00	
U-238	RFO-DOW-16H	51.3	7.62E+01	Depleted uranium (roaster oxide)
	RFO-DOW-3H	18.8	2.79E+01	Uncemented sludge
	PDA-RFO-1A	16.8	2.49E+01	Evaporator salt (nitrate) and roaster oxides (depleted uranium) on Pad A
	LLW—trash	5.0	7.39E+00	2000 to 2009 miscellaneous LLW
	SMC-628-2	1.5	2.31E+00	Unsolidified slag
	ARA-627-1H	1.1	1.64E+00	Plastic bags, brick, HEPA filters, scrap, glove boxes, and fuel
	Miscellaneous ^b	5.5	8.14E+00	Mostly debris, some fuel-contaminated waste, and ingrowth from Rocky Flats Plant Pu-242
Total U-238		100.0	1.48E+02	

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project at the Subsurface Disposal Area.

b. "Miscellaneous" indicates numerous waste streams that contribute less than 1% to the total. These waste streams are combined for this table, but are explicitly included with the appropriate release mechanism in the release simulations.

HEPA = high-efficiency particulate air

LLW = low-level waste

TAN = Test Area North

Table 4-5. Rocky Flats Plant plutonium-238, -239, and -240 waste streams and best-estimate inventories (curies) at time of disposal.

Contaminant	Waste Type	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
Pu-238	Graphite	27.8	5.13E+02	Molds, crucibles, and scarfings
	Type III	19.8	3.65E+02	Filters
	Type I and V	18.6	3.43E+02	Debris
	Line-generated waste	15.5	2.86E+02	Line-generated waste (e.g., gloves and glove boxes)
	Series 741	12.3	2.28E+02	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)
	Type I	5.4	1.00E+02	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)
	Series 744	0.3	5.61E+00	Series 744 sludge (special setups)
	Series 743	0.3	4.85E+00	Series 743 sludge (organic)
	Series 745	0.0	1.79E-01	Series 745 nitrate salt
Total Rocky Flats Plant Pu-238		100.0	1.85E+03	
Pu-239	Graphite	26.5	1.67E+04	Molds, crucibles, and scarfings
	Type III	18.8	1.19E+04	Filters
	Type I and V	17.7	1.12E+04	Debris
	Line-generated waste	14.8	9.31E+03	Line-generated waste (e.g., gloves and glove boxes)
	Series 741	11.8	7.42E+03	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)
	Type I	5.2	3.26E+03	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)
	Type II	4.7	2.93E+03	Glass
	Series 744	0.3	1.83E+02	Series 744 sludge (special setups)
	Series 743	0.2	1.58E+02	Series 743 sludge (organic)
	Series 745	0.0	5.82E+00	Series 745 nitrate salt
Total Rocky Flats Plant Pu-239		100.0	6.30E+04	
Pu-240	Fraction	0.037	2.33E+03	Simulated mobile fraction
	Fraction	0.963	6.07E+04	Sorbing fraction
	Graphite	26.4	3.72E+03	Molds, crucibles, and scarfings
	Type III	18.8	2.64E+03	Filters
	Type I and V	17.7	2.50E+03	Debris

Table 4-5. (continued).

Contaminant	Waste Type	Portion in Waste Stream (%)	Inventory (Ci) ^a	Waste Stream Description
	Line-generated waste	14.8	2.09E+03	Line-generated waste (e.g., gloves and glove boxes)
	Series 741	11.8	1.66E+03	Series 741 and 742 sludge (e.g., inorganic first- and second-stage sludge)
	Type I	5.2	7.29E+02	Combustible materials (e.g., paper, rags, plastic, clothing, wood, and polyethylene bottles)
	Type II	4.7	6.57E+02	Glass
	Series 744	0.3	4.09E+01	Series 744 sludge (special setups)
	Series 743	0.3	3.54E+01	Series 743 sludge (organic)
	Series 745	0.0	3.57E-01	Series 745 nitrate salt
Total Rocky Flats Plant Pu-240		100.0	1.41E+04	
		Fraction 0.037	5.20E+02	Simulated mobile fraction
		Fraction 0.963	1.35E+04	Sorbing fraction

a. Estimates have not been adjusted for inventory removed by the Accelerated Retrieval Project at the Subsurface Disposal Area.

Table 4-6. Nitrate and chromium waste streams and best-estimate inventories (grams) at time of disposal.

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (g)	Waste Stream Description
Nitrate (as nitrogen)	PDA-RFO-1A	51.6	2.35E+08	Evaporator salts
	RFO-DOW-17H	37.5	1.71E+08	Evaporator salts
	CPP-601-4H	10.8	4.95E+07	Aqueous chemicals
	Miscellaneous	0.1	2.57E+05	
Total nitrate (as nitrogen)		100.0	4.56E+08	
Chromium	PDA-RFO-1A	78.6	1.82E+06	Evaporator salts
	RFO-DOW-17H	21.4	4.96E+05	Evaporator salts
	Miscellaneous	0.0	1.05E+03	
Total chromium		100.0	2.32E+06	

Table 4-7. Volatile organic compound waste streams and best-estimate inventories (grams) at time of disposal.

Contaminant	Waste Stream Code	Portion in Waste Stream (%)	Inventory (g) ^a	Waste Stream Description
Carbon tetrachloride	RFO-DOW-15H	99.5	7.86E+08	Series 743 sludge (organic)
	Miscellaneous	0.5	3.66E+06	Mostly other Rocky Flats Plant waste
	Total carbon tetrachloride	100.0	7.90E+08	
1,4-Dioxane	RFO-DOW-15H	88.2	1.72E+06	Series 743 sludge (organic)
	RFO-DOW-4H	7.8	1.52E+05	Equipment (drill presses, lathes, and pumps)
	CPP-603-4H	1.9	3.62E+4	Rags
	Miscellaneous	2.1	4.24E+04	Mostly combustible waste
Total 1,4-Dioxane		100.0	1.95E+06	
Methylene chloride	RFO-DOW-3H	51.2	7.21E+06	Uncemented sludge
	RFO-DOW-4H	20.3	2.85E+06	Equipment (e.g., drill presses, lathes, and pumps)
	RFO-DOW-9H	18.3	2.58E+06	Paper, rags, and plastic
	RFO-DOW-12H	9.3	1.31E+06	Dirt, sand, concrete, ashes, and soot
	RFO-DOW-6H	0.9	1.36E+05	Filters
	Total methylene chloride	100.0	1.41E+07	
Tetrachloroethylene	RFO-DOW-15H	100.0	9.87E+07	Series 743 sludge (organic)
Total tetrachloroethylene		100.0	9.87E+07	
Trichloroethylene	RFO-DOW-15H	99.6	8.92E+07	Series 743 sludge (organic)
	Miscellaneous	0.4	4.07E+05	Other Rocky Flats Plant waste
Total trichloroethylene		100.0	8.96E+07	

a. Estimates were not adjusted for inventory removed by the Accelerated Retrieval Project at the Subsurface Disposal Area.



Figure 4-2. Density of americium-241 in the Subsurface Disposal Area.

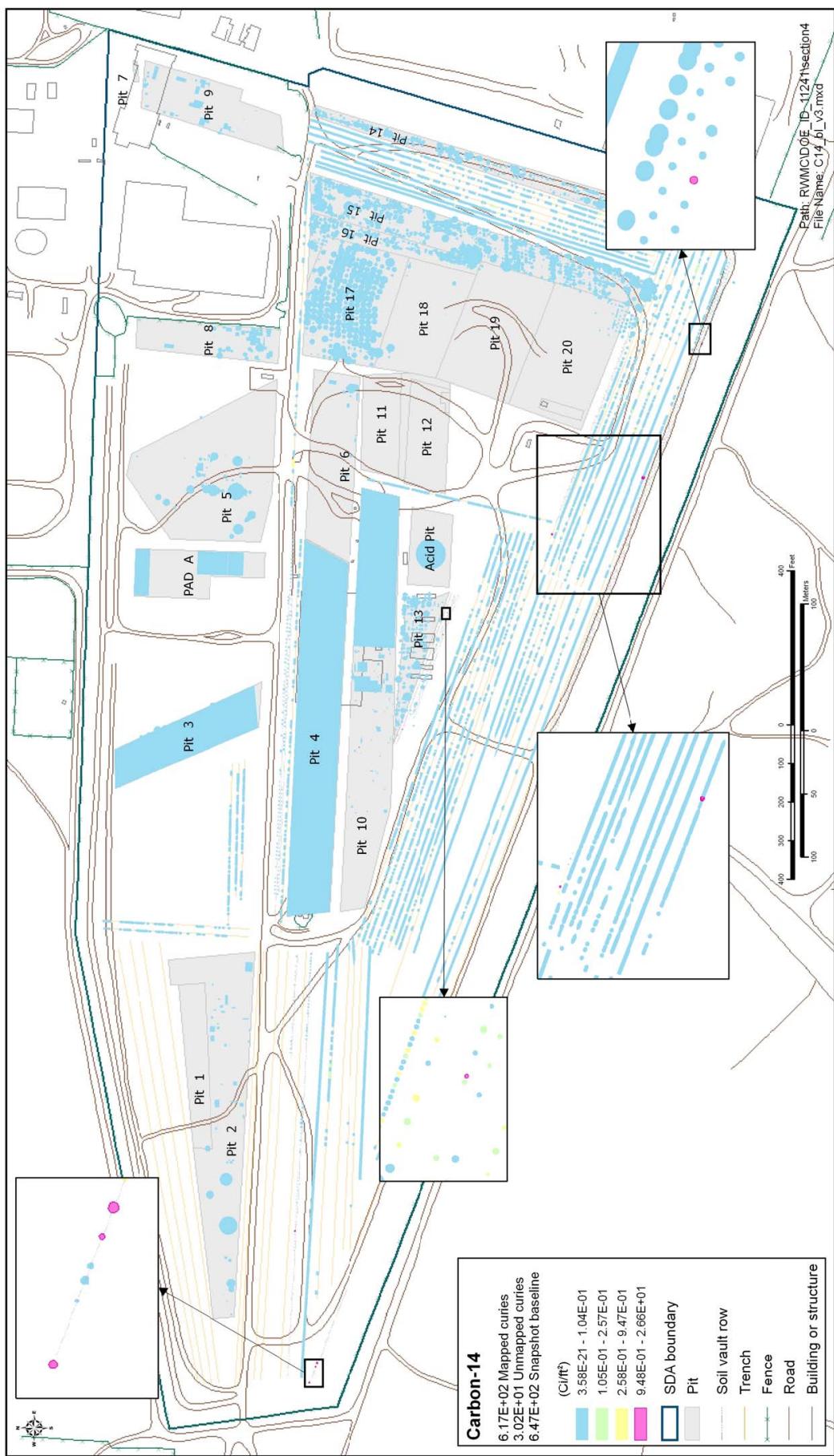


Figure 4-3. Density of carbon-14 in the Subsurface Disposal Area.

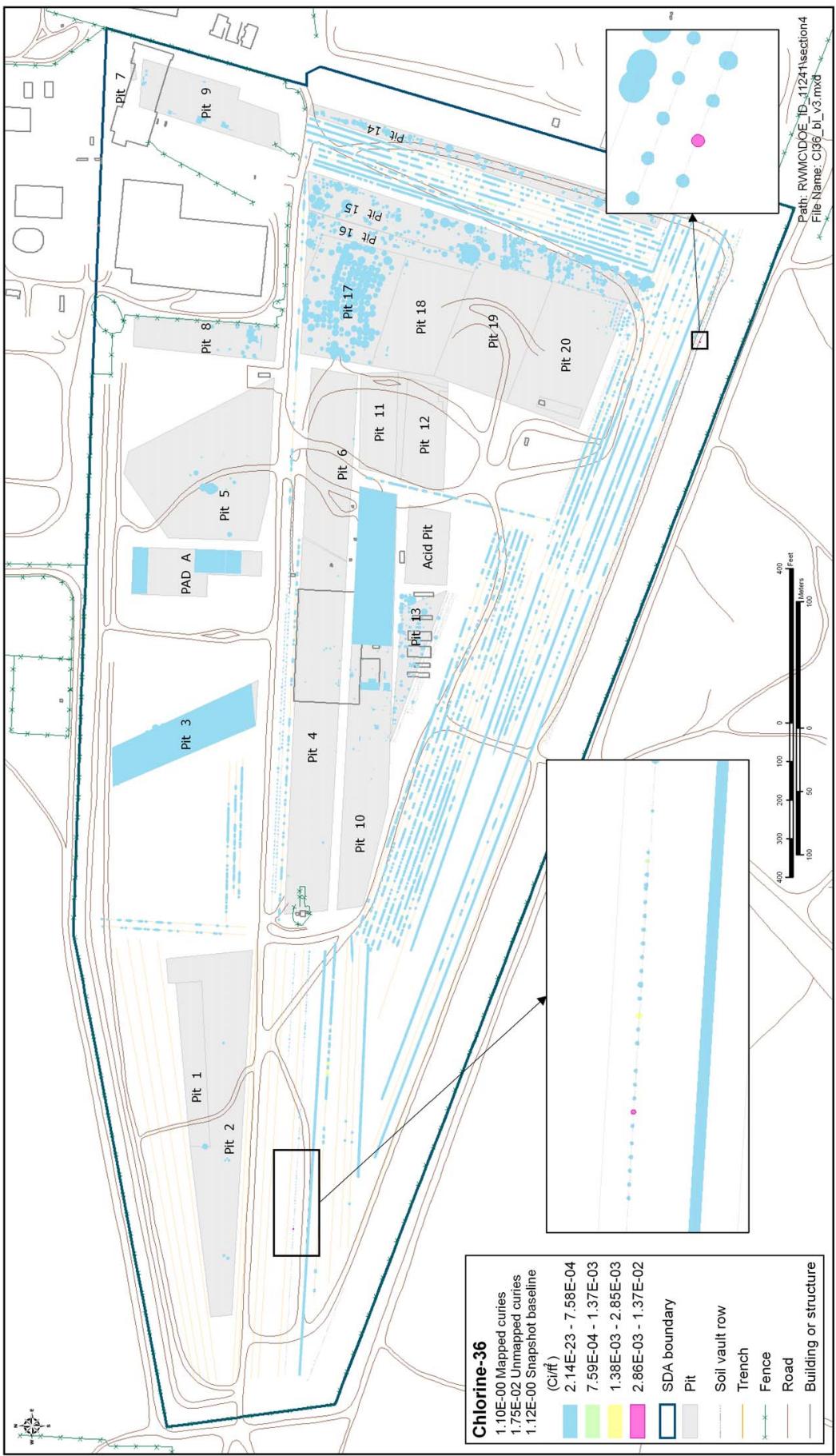


Figure 4-4. Density of chlorine-36 in the Subsurface Disposal Area.



Figure 4-5. Density of cesium-137 in the Subsurface Disposal Area.

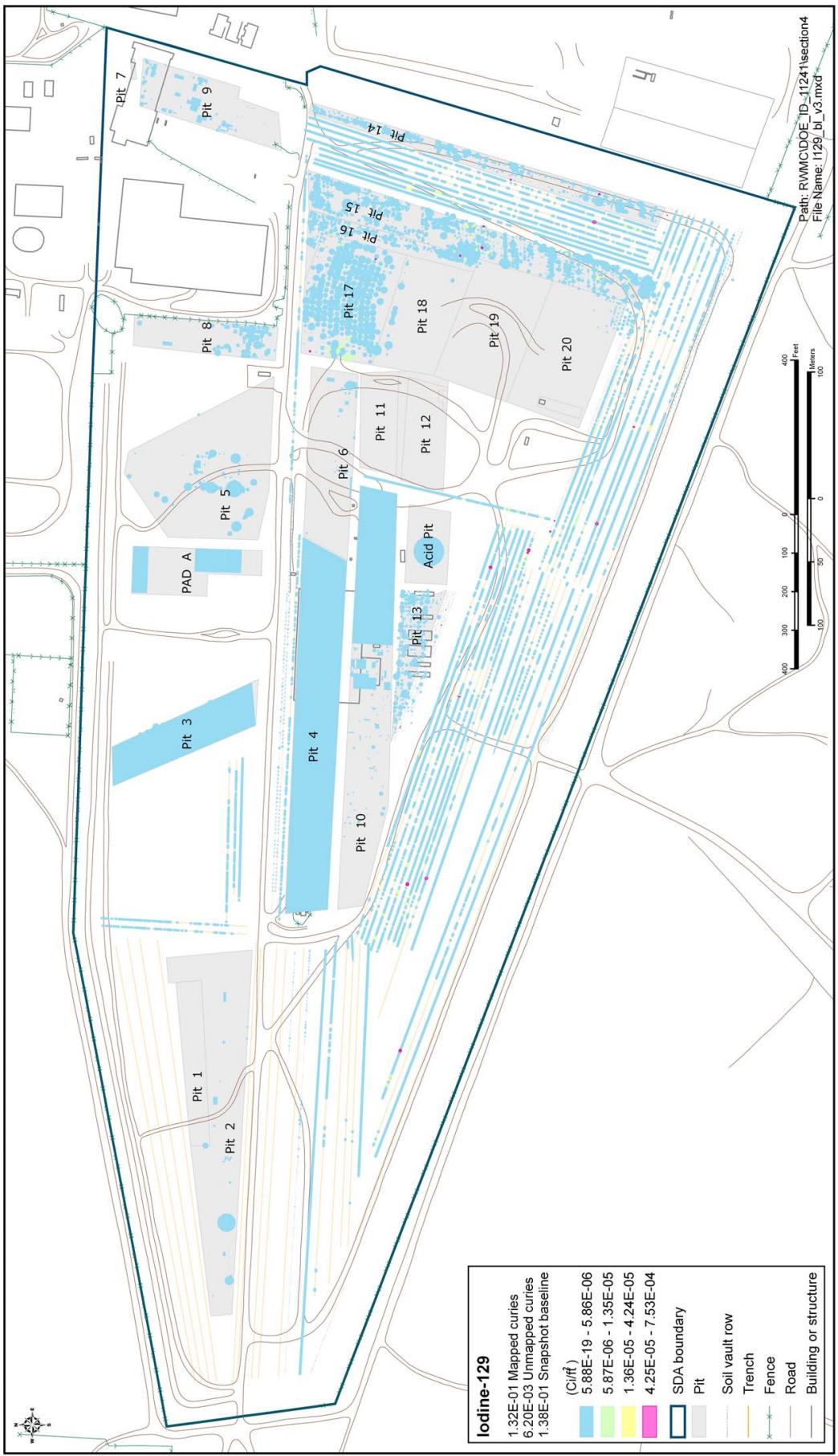


Figure 4-6. Density of all iodine-129 in the Subsurface Disposal Area.



Figure 4-7. Density of releasable iodine-129 in the Subsurface Disposal Area.

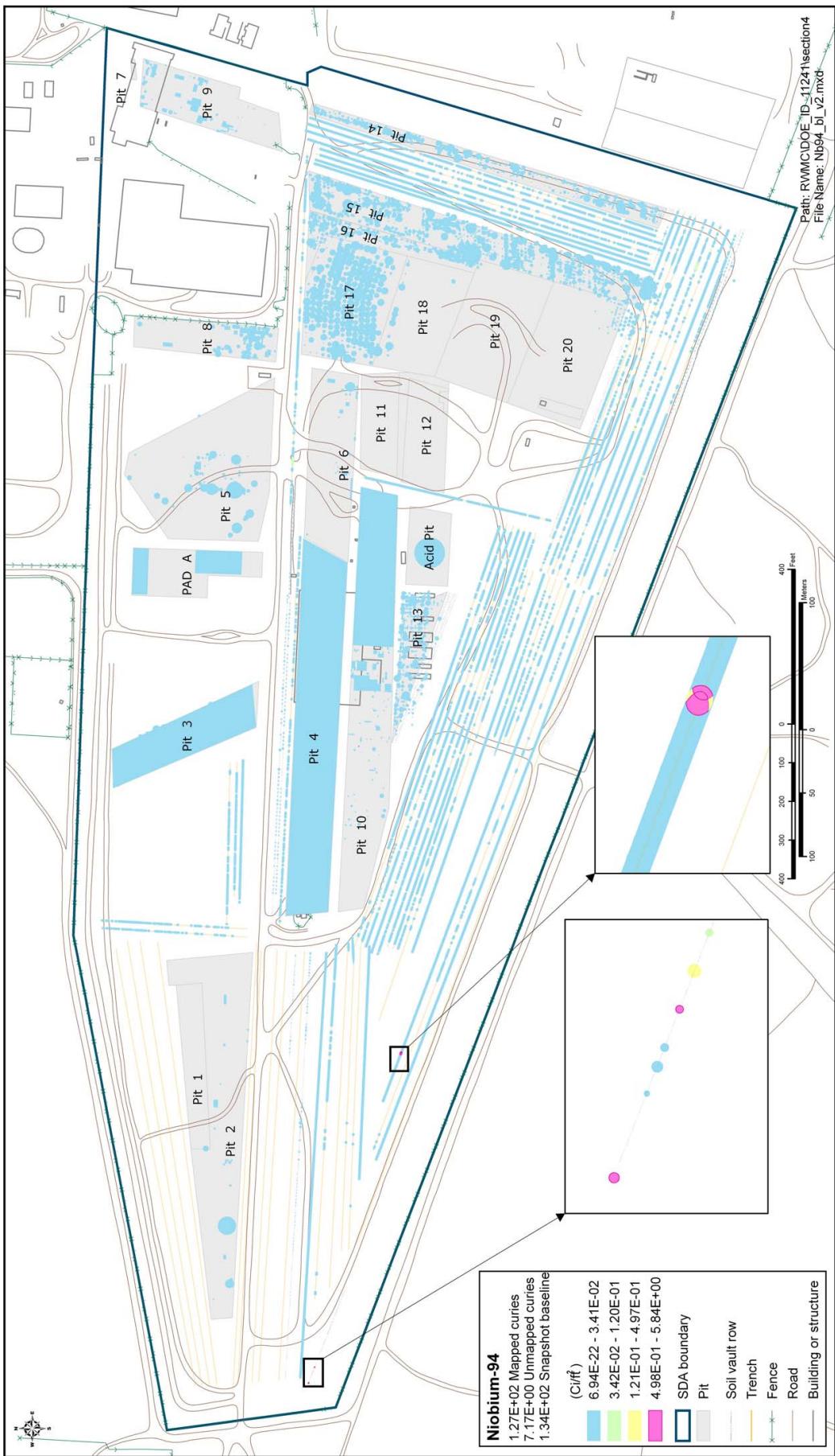


Figure 4-8. Density of niobium-94 in the Subsurface Disposal Area.

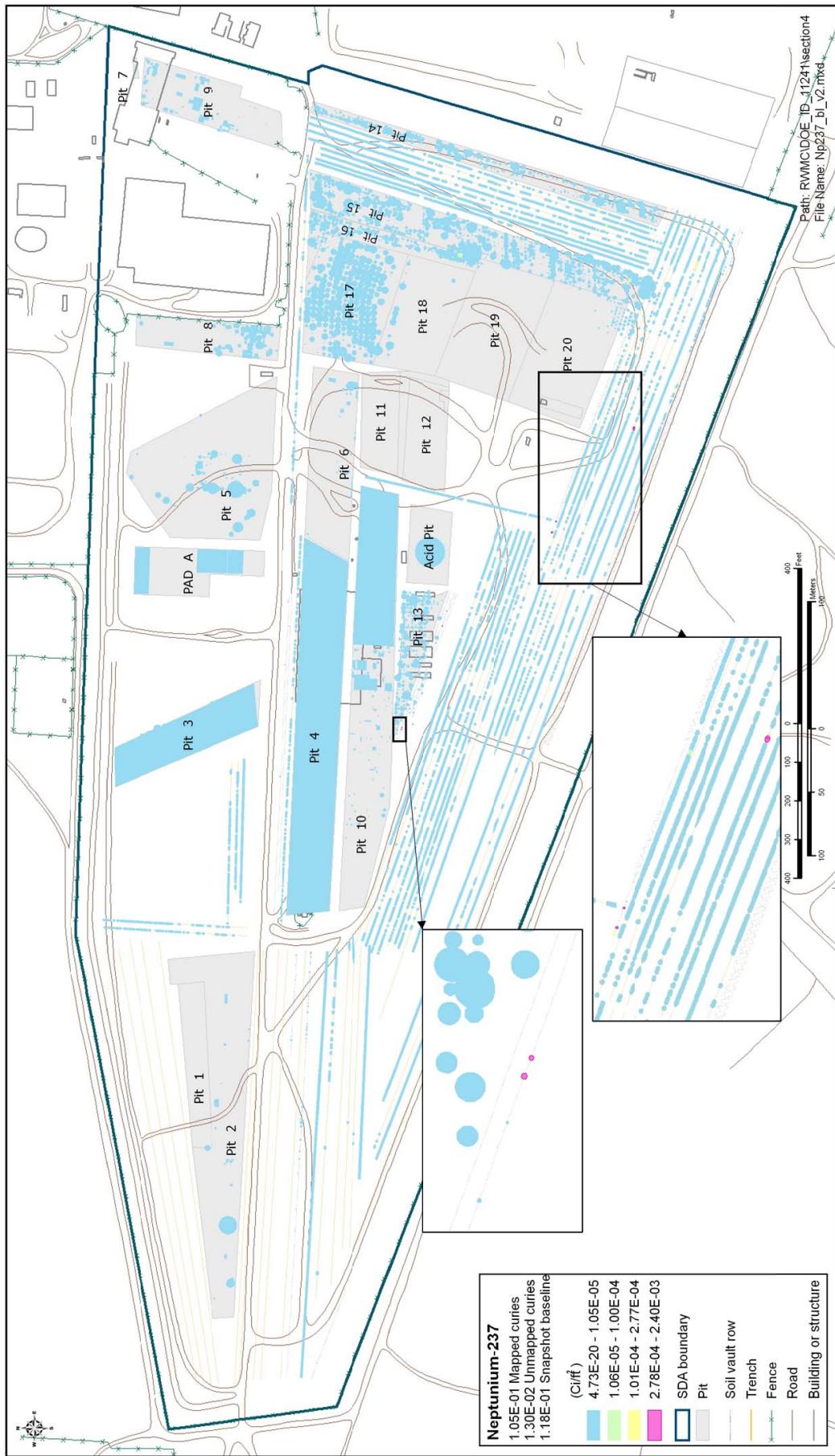


Figure 4-9. Density of neptunium-237 in the Subsurface Disposal Area.



Figure 4-10. Density of plutonium-238 in the Subsurface Disposal Area.



Figure 4-11. Density of plutonium-239 in the Subsurface Disposal Area.